Project Albert: Developing Capabilities, Transitioning to Applications

Brian Widdowson
USMC M&S Review – 4 Nov 2003

Audience Calibration

- Who is familiar is Project Albert?
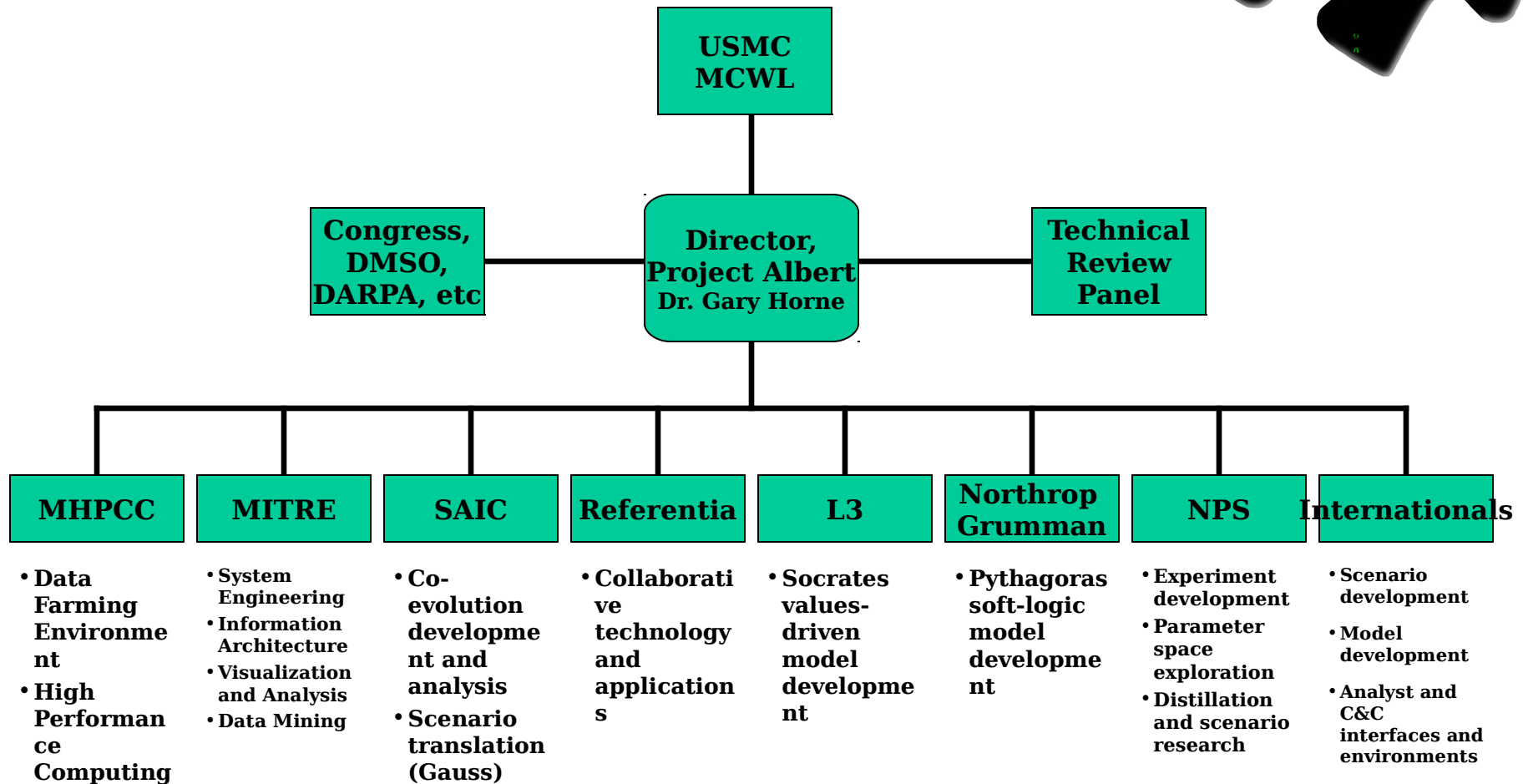
- Who knows what "Data Farming" is?

What is Project Albert?

- **Chartered by Congress with the vision to address questions of military decision-makers not supported by traditional methods**
- **Leverages High Performance Computing in innovative ways**
- **Stresses interdisciplinary, joint, and coalition collaboration**
- **Supports rapid investigation of a wide range of alternatives in a new** a farming
- **Applications efforts of shallow cles, control, and fo**
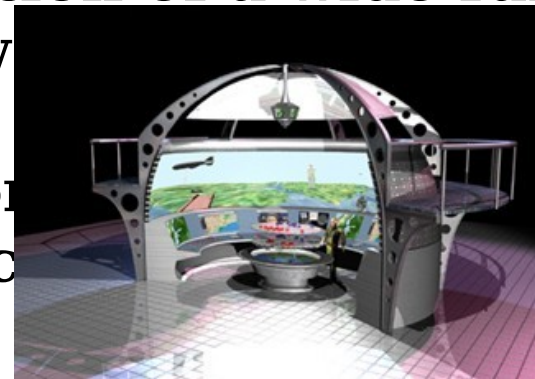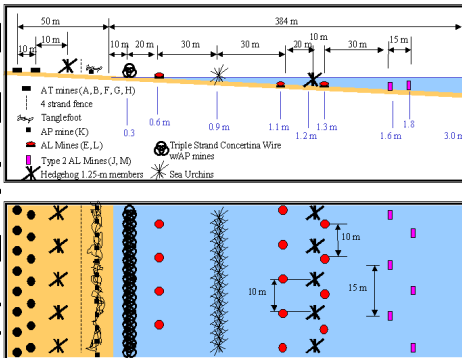
Project Albert:
Organization

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                              │  USMC       │
                              │  MCWL       │
                              └──────┬──────┘
                                     │
┌─────────────┐            ┌─────────┴─────────┐            ┌─────────────┐
│ Congress,   │            │  Director,        │            │ Technical   │
│ DMSO,       │────────────│  Project Albert   │────────────│ Review      │
│ DARPA, etc  │            │  Dr. Gary Horne   │            │ Panel       │
└─────────────┘            └─────────┬─────────┘            └─────────────┘
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MHPCC	MITRE	SAIC	Referentia	L3	Northrop Grumman	NPS	Internationals
• **Data Farming Environment** • **High Performance Computing**	• System Engineering • Information Architecture • Visualization and Analysis • Data Mining	• **Co-evolution development and analysis** • **Scenario translation (Gauss)**	• **Collaborative technology and applications**	• **Socrates values-driven model development**	• **Pythagoras soft-logic model development**	• Experiment development • Parameter space exploration • Distillation and scenario research	• Scenario development • Model development • Analyst and C&C interfaces and environments

Fundamental Idea

Leverage high performance computing to run **model** scenarios many times.

Developing Capabilities

Data Farming

- **Distillation Models**
- **High Performance Computing**
- **Data Visualization**
- **Rapid Prototyping Processes**
- **Parameter Space Exploration**
- **Model Translation and Integration**
- **Collaborative Environments**

Goal

Support decision makers in meaningful ways through modeling, analysis, and new ways of combining them to include important phenomena inadequately represented by current techniques.

Quantifying 3 Phenomena

- ***Non-linearity***
  - Small change in initial conditions may lead to large change in result
  - Change in particular parameters may lead to leap in outputs
  - One event can totally change scenario
- ***Intangibles***
  - Leadership
  - Trust
  - Bravery
  - Etc.
- ***Coevolution***
  - I think he thinks…
 - He thinks that I think that he thinks…

Question Based

- **When and how should C2 be centralized or decentralized?**
- **What is the appropriate force mix required for operations in a littoral environment?**
- **What are the relative merits of firepower, mobility, situational awareness, stealth, and information operations in a reconnaissance/ counter reconnaissance situation?**
- **How can we best protect our homeland from a martyr-based offense?**
- **How can we deal with shallow water obstacles?**
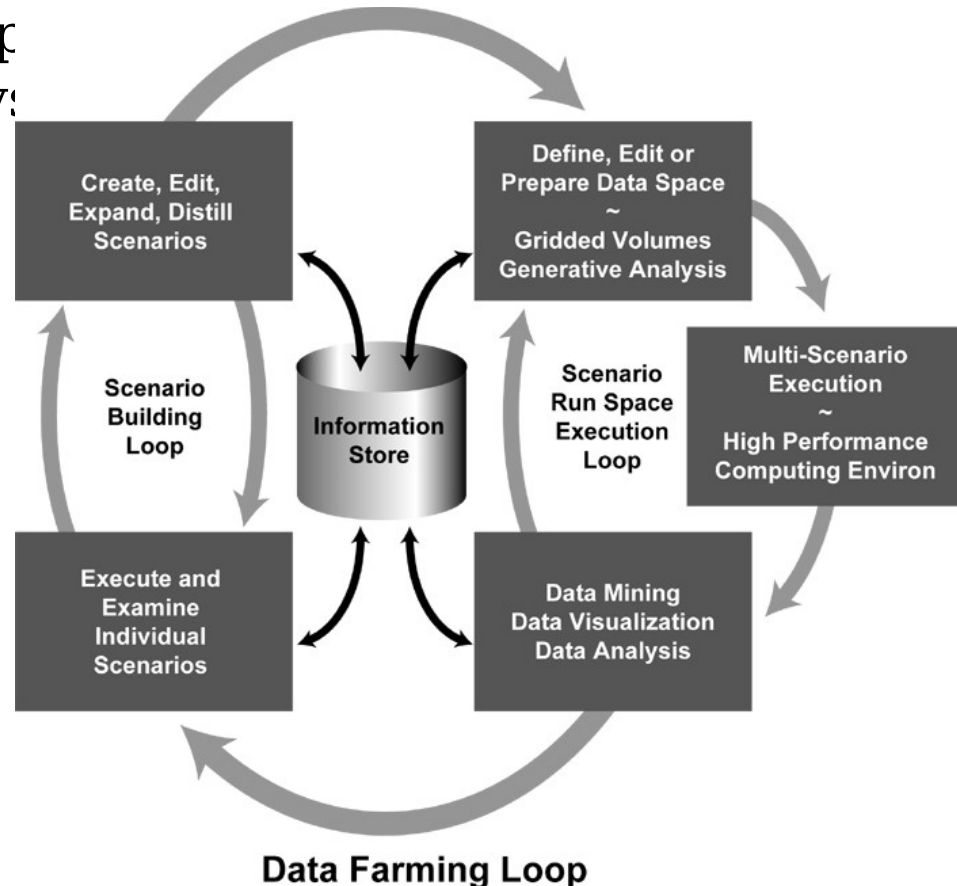- **……**

Project Albert:
Distillations

- **Distillations - Simulation, experiment or prototype that is intuitive, transparent, transportable, and farmable**
- **A bottom up distillation of the essence of a**
- **Fast prototype - less than a few hours eventually minutes**
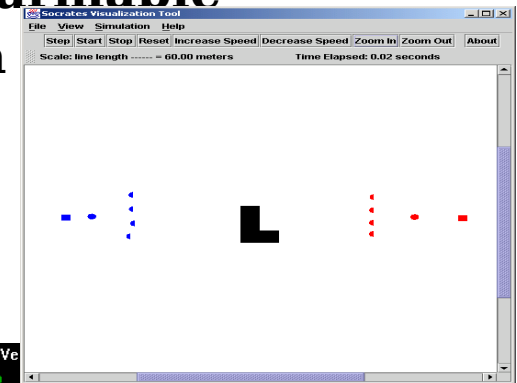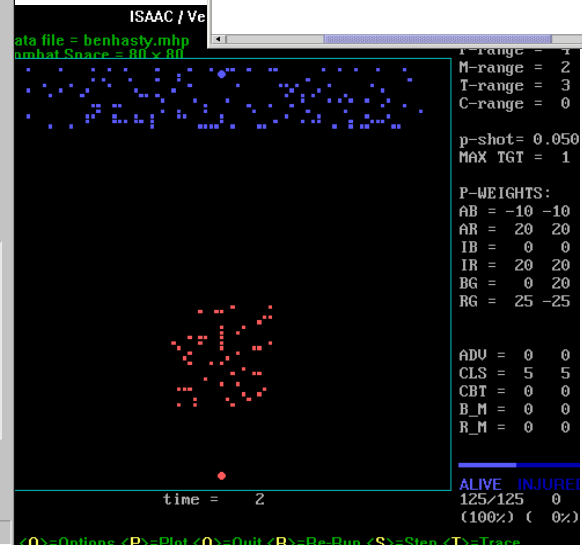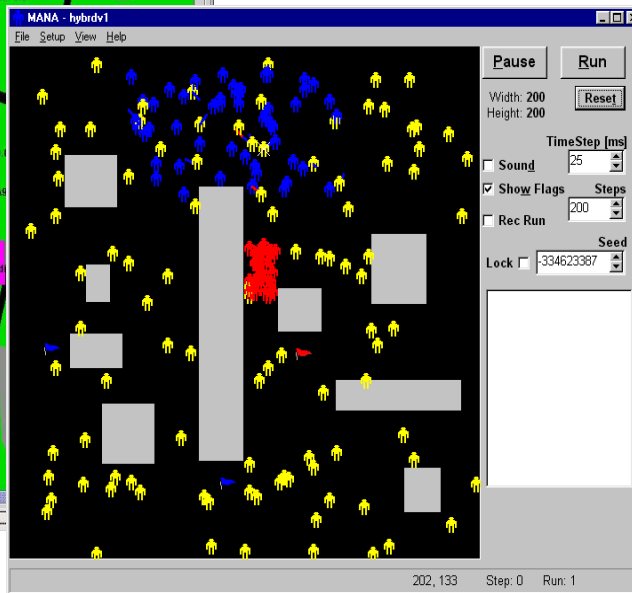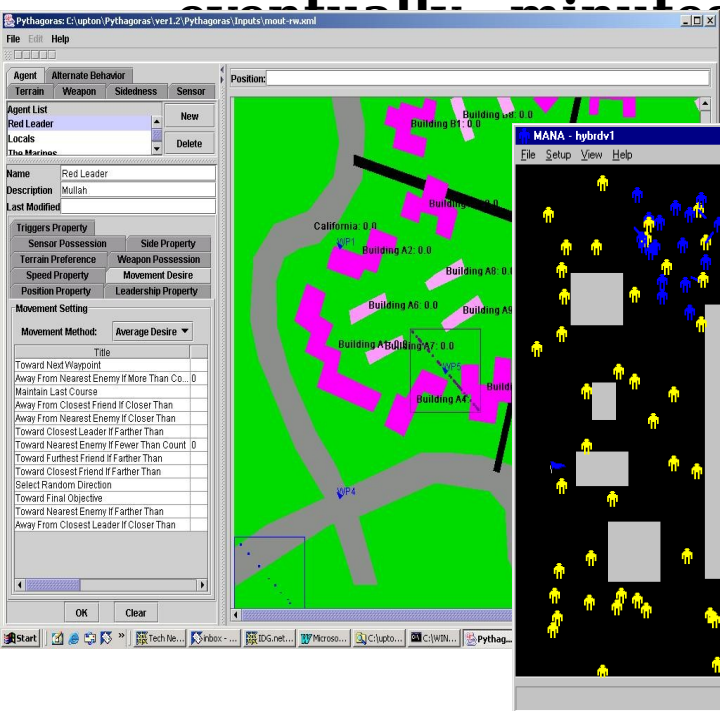
Project Albert:
Data Farming

- Execute **MODELS** varying initial conditions and parameters
- Explore resultant data space using visualization/analysis tools
- Grow data using high-performance computing

Create, Edit, Expand, Distill Scenarios

Define, Edit or Prepare Data Space ~ Gridded Volumes Generative Analysis

Scenario Building Loop

Information Store

Scenario Run Space Execution Loop

Multi-Scenario Execution ~ High Performance Computing Environ

Execute and Examine Individual Scenarios

Data Mining Data Visualization Data Analysis

Data Farming Loop

Gridded Data

- Grow Data by:

Adding dimensions

Expanding
bounds

Increasing fidelity

Increasing trials

5
Trials

Sensor

Fire Range

Pshot

100
Trials

Project Albert:
Why is it Important?

- Distillations have potential to provide extremely fast turn-around analysis of appropriate operational problems.

  – Distillation scenarios take only a few hours, sometimes even minutes to model and hours to a few days to produce vast amounts of data for analysis.

  – Data Farming may allow for identification of risks and opportunities on the battlefield for different situations, providing commanders the ability to exploit their advantages and mitigate their disadvantages.

- Distillations can complement traditional operations analysis through attempting to capture the effects of non-linearities, intangibles, and co-evolving decision making processes on the outcomes of conflict.

Project Albert:
Current efforts?

- Interface with developers
- Aid the Sea Viking experimentation process using Project Albert capabilities and tools
- Provide technical expertise for conferences, seminars, workshops
- Support evolution of Project Albert rapid prototyping process
- Coordinate production of Maneuver Warfare Science publication
- Collaborate on various research studies with USMA, CAA, USAF, DOE labs
- Automate Data Farming process
- Develop methods for dealing with large, multi-dimensional data sets

Recent Applications

PAIW 7 – Quantico

- **Week One**
  - Germany
  - Australia
  - Singapore
  - NPS
  - LANL
  - USMC

- **Week Two**
  - Germany
  - Sweden
  - New Zealand
  - Canada
  - Australia
  - USAF
  - NPSWeek

- **Week Three**
  - Germany
  - New Zealand
  - NPS
  - Department of Homeland Security
  - U.S. Special Operations Command
  - LANL
  - SNL
  - University of Pennsylvania

Are we joint?

Military

- USMC
- Navy
- Army
- Air Force
- Coast Guard

Nations

- Australia
- Canada
- England
- Germany
- New Zealand
- Singapore
- Sweden

Organizations

- DOD
- DOE
- Private Industry
- Academia
- USGCs

Attacking Our Questions

Past Project Albert International Workshops

- **PAIW I, August 1999, MHPCC**
- **PAIW II, January 2000, MHPCC**
- **PAIW III, February 2001, New Zealand**
- **PAIW IV, August 2001, Australia**
- **PAIW V, July 2002, Germany**
- **PAIW VI, March 2003, Monterey, CA**
- **PAIW VII, September 2003, Quantico, VA**
- **PAIW VIII, April 2004, Singapore**

...plus preliminary workshops, working session

Challenges

- Models available do not support all user's needs
  - Capability
  - Complexity
  - Effective user interfaces
- Integrating models into the data farming environment
- Analysis & Visualization of massive Data Sets
- C4ISR Relationships

www.projectalbert.org

widdowson@mitre.org

Backup Slides

Project Albert:
Recent Applications

Project Albert International Workshop 6

• Held 9-14 March 2003 at NPS

• 10 Working Groups from USA, Australia, Germany, Singapore

• Each Group Leader/Group required to publish article in *Maneuver Warfare Science 2003* documenting conference research

• Approximately 500 - 750K scenario runs generated over 3.5 days

Shallow Water Obstacles	USMC	C2 and Future Conflicts	
Communications in Sensor Networks		USMC	
Singapore		MOUT	US Army
Enhanced Blast Weapons	USMC	Entry from the Air and Sea	Australia
Expeditionary Logistics		Force Protection	US Army
USMC		Peace Support Operations	Germany
Homeland Defense	USA		